STATUS OF THE CLAIMS

1. (CURRENTLY AMENDED) A method of indexing multimedia documents, the method being characterized in that it comprises the following steps:

a) for each multimedia document, identifying and extracting terms t_i constituted by vectors characterizing properties of each of the multimedia documents for indexing, which characterizing properties include at least one of ~~such as~~ shape, texture, color, and ~~or~~ structure of an image, an ~~the~~ energy level, an ~~the~~ oscillation rate or frequency information of an audio signal, and ~~or~~ a group of characters of a text;

b) storing the terms t_i characterizing the properties of each of the multimedia documents in a term base comprising a set of P terms, where P is an integer;

c) determining a maximum number (N) of desired concepts combining ~~the most~~ pertinent terms t_i, where N is an integer less than P, with each concept c_i being designed to combine all terms t_i based on a relationship of ~~that are neighboring from the point of view of~~ their characterizing properties ~~characteristics~~;

d) calculating a ~~the~~ matrix T of distances between the terms t_i of the term base of P terms;

e) decomposing the set of P terms ~~of terms t_i of the term base~~ into N portions P_j ($1 \leq j \leq N$) such that the set of P terms = $P_1 \cup P_2 \ldots \cup P_j \ldots \cup P_N$, each portion P_j comprising a set of terms t_{ij} and being represented by a concept c_j, the terms t_i being distributed in such a manner that terms that are farther away are

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to be found in distinct portions P_l, P_m while terms that are closer together are to be found in the same portion P_l;

f) structuring a concept dictionary so as to constitute a binary tree in which each leaf of the binary tree ~~the leaves~~ contains a~~the~~ concept[[~~s~~]] c_i of the dictionary and each node~~the nodes~~ of the binary tree contains ~~the~~ information necessary for scanning the tree during a stage of identifying a multimedia document by comparing it with previously-indexed documents; and

g) constructing a fingerprint base made up of a~~the~~ set C of concepts c_i representing the terms t_i of the multimedia documents to be indexed, each multimedia document being associated with a fingerprint that is specific thereto.

2. (CURRENTLY AMENDED) ~~An indexing method~~A method of indexing multimedia documents according to claim 1, characterized in that each concept c_i of the fingerprint base is associated with a data set comprising a~~the~~ number of terms, in~~No.~~ T, in the multimedia documents in which said~~the~~ concept c_i is present.

3. (CURRENTLY AMENDED) ~~An indexing method~~A method of indexing multimedia documents according to claim 1, characterized in that for each multimedia document having a corresponding ~~in which a~~ concept c_i ~~is present~~, a fingerprint of the corresponding concept c_i is registered in the multimedia document, said fingerprint containing at least one of a~~the~~ frequency of occurrence of ~~with which~~ the corresponding concept c_i ~~occurs~~, ~~the~~ identities of concepts neighboring the corresponding concept c_i in the multimedia document, and a score which is a mean value of similarity measurements between the corresponding concept c_i and

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the terms t_i of the multimedia document that are most proximate ~~the closest~~ to the corresponding concept c_i.

4. (CURRENTLY AMENDED) ~~An indexing method~~A method of indexing multimedia documents according to claim 1, further comprising:~~characterized in that it comprises a step of~~

optimizing the step of decomposing ~~partitioning of~~ the set of P ~~of~~ terms of the term base by decomposing ~~to decompose~~ said set of P terms into M classes C_i (in which $1 \leq i \leq M$, where M is an integer and $M \leq P$), so as to reduce a ~~the~~ distribution error of the set of P ~~of~~ terms in the term base into N portions (P_1, P_2, …, P_N) where each portion P_i is represented by the terms t_i that are~~is~~ taken as the concept c_i,

the distribution error that is committed (ε) being such that:

$$\varepsilon = \sum_{i=1}^{N} \varepsilon_{t_i},$$

wherein $\varepsilon_{t_i} = \sum_{t_j \in P_i} d^2(t_i, t_j)$ is the distribution error committed by replacing the terms t_j of a portion P_i with the terms t_i.

5. (CURRENTLY AMENDED) ~~An indexing method~~A method of indexing multimedia documents according to claim 4, characterized in that it comprises the following steps:

i) decomposing the set of P ~~of~~ terms into two portions (P_1 and P_2);

ii) determining a first term~~the two terms~~ t_i and a second term t_j of the set of P terms that are ~~the~~ f~~a~~rthest apart,

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corresponding to a~~the~~ greatest distance D_{ij} of the ~~distance~~ matrix T of distances;

iii) for each term t_k of the set of P terms, examining to see whether a~~the~~ distance D_{ki} between the term t_k and~~of~~ the first term t_i is less that a~~the~~ distance D_{kj} between the term t_k and the second term t_j, and if so, allocating the term t_k to the portion P_1, and otherwise allocating the term t_k to the portion P_2; and

iv) iterating step (i) until a~~the~~ desired number N of portions P_i has been obtained, and on each iteration applying the steps (ii) and (iii) on the first and second terms of the portions P_1 and P_2.

6. (CURRENTLY AMENDED) ~~An indexing method~~A method of indexing multimedia documents according to claim 4, further comprising:~~characterized in that it includes~~

optimization starting from N disjoint portions $\{P_1, P_2, \ldots, P_N\}$ of the set of P terms and N terms $\{t_1, t_2, \ldots, t_N\}$ representing them in order to reduce a~~the~~ decomposition error of the set of P terms into N portions, further comprising~~and in that it comprises the following steps~~:

i) calculating a corresponding ~~the~~ center~~s~~ of gravity C_i for each ~~of the~~ portion[[~~s~~]] P_i;

ii) calculating a corresponding decomposition error using:

~~errors~~ $\varepsilon C_i = \sum_{t_j \notin Pi} d^2(C_i, t_j)$,

replacing the terms t_j by center of gravity terms C_i; and calculating a corresponding distribution error using:

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$$\varepsilon t_i = \sum_{t_j \in P_i} d^2(t_i, t_j)$$

~~when~~by replacing the terms t_j ~~of the portion P_i respectively~~ by ~~C_i and by~~ the terms t_i;

iii) comparing εt_i and εC_i the terms t_i by the center of gravity terms C_i if $\varepsilon C_i \leq \varepsilon t_i$; and

iv) calculating a new distance matrix T between the terms t_i of the term base and ~~the process of~~ decomposing the set of P ~~of~~ terms of the term base into N portions, unless a stop condition is satisfied with

$$\frac{\varepsilon C_t - \varepsilon C_{t+1}}{\varepsilon C_t} < \text{threshold},$$

where εc_t represents the decomposition error committed at instant t.

7. (CURRENTLY AMENDED) ~~An indexing method~~A method of indexing multimedia documents according to claim 1, wherein ~~characterized in that for the purpose of~~ structuring the concept dictionary includes:~~,~~

producing a navigation chart ~~is produced~~ iteratively on each iteration, ~~beginning~~ by splitting the set C of concepts into two subsets, and then selecting one subset on each iteration until a~~the~~ desired number of groups is obtained or until a stop criterion is satisfied.

8. (CURRENTLY AMENDED) ~~An indexing method~~A method of indexing multimedia documents according to claim 7, wherein ~~characterized in that~~ the stop criterion is satisfied when ~~is constituted by the~~

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~~fact that~~ each of the two subsets obtained is~~are all~~ homogeneous and has a~~with~~ small standard deviation.

9. (CURRENTLY AMENDED) ~~An indexing method~~A method of indexing multimedia documents according to claim 7, wherein ~~characterized in that during the~~ structuring ~~of~~ the concept dictionary includes:~~,~~

determining navigation indicators ~~are determined~~ from a matrix $M = [c_1, c_2, \ldots, c_N] \in \Re^{p*N}$ ~~–~~of the set C of concepts $c_i \in \Re^p$ where c_i represents a concept of p values, by implementing the following steps:

i) calculating a representative *w* of the matrix M;

ii) calculating a~~the~~ covariance matrix $\tilde{M}$ between ~~the~~ elements of the matrix M and the representative *w* of the matrix M;

iii) calculating a projection axis *u* for projecting the elements of the matrix M;

iv) calculating a~~the~~ value pi = d(*u*,Ci) – d(*u*,*w*) and decomposing the set C of concepts [[~~C~~]] into two subsets (C1 and C2) as follows:

$$\begin{cases} c_i \in C1 \text{ if } pi \leq 0 \\ c_i \in C2 \text{ if } pi > 0 \end{cases}$$

v) storing a data set ~~the information~~ {u, w, |p1|, p2} in a~~the~~ node associated with the set C of concepts, where p1 is a~~the~~ maximum of all pi ≤ 0 and p2 is a~~the~~ minimum of all pi > 0, the data set {u, w, |p1|, p2} constituting the navigation indicators in the concept dictionary.

10. (CURRENTLY AMENDED) ~~An indexing method~~A method of indexing multimedia documents according to claim 1, characterized in that

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~~both the~~ structural components and ~~the~~ complements of said structural components constituted by ~~the~~ textural components of the~~an~~ image of the multimedia document are analyzed, and in that:

a) while analyzing the structural components of the image:

a1) boundary zones of ~~the~~ image structures are distributed into different classes depending on an~~the~~ orientation of a ~~the~~ local variation in intensity so as to define structural support elements (SSEs) of the image; and

a2) performing statistical analysis to construct terms constituted by vectors describing ~~the~~ local properties and ~~the~~ global properties of the structural support elements;

b) while analyzing the textural components of the image:

b1) detecting and performing parametric characterization of a purely random component of the image;

b2) detecting and performing parametric characterization of a periodic component of the image; and

b3) detecting and performing parametric characterization of a directional component of the image;

c) grouping a~~the~~ set of descriptive elements of the image in a limited number of concepts constituted firstly by ~~the~~ terms describing the local properties and the global properties of structural support element and secondly by ~~the~~ parameters of the parametric characterizations of the random, periodic, and directional components defining the textural components of the image; and

d) for each document, defining a fingerprint from ~~the~~ occurrences, ~~the~~ positions, and ~~the~~ frequencies of said limited number of concepts.

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11. (CURRENTLY AMENDED) ~~An indexing method~~A method of indexing multimedia documents according to claim 10, characterized in that the local properties of the structural support elements taken into consideration for constructing terms comprise at least one of ~~the support types selected from amongst~~ a linear strip or a curved arc as a support, ~~the~~ length and width dimensions of the support, a~~the~~ main direction of the support, and a~~the~~ shape and ~~the~~ statistical properties of ~~the~~ pixels constituting the support.

12. (CURRENTLY AMENDED) ~~An indexing method~~A method of indexing multimedia documents according to claim 10, characterized in that the global properties of the structural support element taken into account for constructing terms comprise at least a~~the~~ number of each type of support and a~~the~~ spatial disposition thereof.

13. (CURRENTLY AMENDED) ~~An indexing method~~A method of indexing multimedia documents according to claim 10, wherein~~characterized in that~~ during analysis of the structural components of the image, a prior test is performed to detect whether at least one structure is present in the image, and in the absence of any structure, the method passes directly to the step of analyzing the textural components of the image.

14. (CURRENTLY AMENDED) ~~An indexing method~~A method of indexing multimedia documents according to claim 10, characterized in that in order to distribute~~decompose~~ boundary zones of the image structures into different classes, starting from a~~the~~ digitized image defined by a~~the~~ set of pixels $y(i,j)$ where $(i,j) \in I \times J$, where I and J designate, respectively, a~~the~~ number of rows and a~~the~~ number of columns of the image, a~~the~~ vertical gradient image

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$g_v(i,j)$ where $(i,j) \in I \times J$, and a~~the~~ horizontal gradient image $g_h(i,j)$ with $(i,j) \in I \times J$ are calculated, and the image is partitioned depending on a~~the~~ local orientation of its gradient into a finite number of equidistant classes, the image containing the local orientation of its~~the~~ gradient being defined by the equation:

$$O(i,j) = \arctan\left[\frac{gh(i,j)}{gv(i,j)}\right]$$

the classes constituting support regions likely to contain significant support elements are identified, and based on ~~the basis of~~ the support regions, significant support elements are determined and indexed using predetermined criteria.

15. (CURRENTLY AMENDED) ~~An indexing method~~A method of indexing multimedia documents according to claim 1, characterized in that while indexing a multimedia document comprising video signals, terms t_i are selected that are constituted by key-images representing groups of consecutive homogeneous images, and concepts c_i are determined by grouping together terms t_i.

16. (CURRENTLY AMENDED) ~~An indexing method~~A method of indexing multimedia documents according to claim 15, characterized in that in order to determine key-images constituting terms t_i, a score vector SV is initially generated comprising a set of elements SV(i) representative of a~~the~~ difference or similarity between a first ~~the~~ content of an image of index i and a second ~~the~~ content of an image of index i-1, and the score vector SV is analyzed in order to determine key-images which correspond to maximums of ~~the~~ values of the set of elements SV(i) of the score vector SV.

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17. (CURRENTLY AMENDED) ~~An indexing method~~A method of indexing multimedia documents according to claim 16, characterized in that an image of index j is considered as being a key-image if:

~~–~~a~~the~~ value SV(j) of a~~the~~ corresponding element of the score vector SV is a maximum and the value SV(j) is situated between two minimums minL and minR, and

a~~if the~~ minimum M1 given by~~such that~~

$$M1 = (|SV\sout{VS}_{(j)} - minL|, |SV_{(j)} - minR|)$$

is greater than a given threshold.

18. (CURRENTLY AMENDED) ~~An indexing method~~A method of indexing multimedia documents according to claim 1, characterized in that while indexing a multimedia document comprising audio components, the multimedia document is sampled and decomposed into frames, which frames are further~~subsequently~~ grouped together into clips that are each ~~being~~ characterized by ~~a~~ terms t_i constituted by a parameter vector.

19. (CURRENTLY AMENDED) ~~An indexing method~~A method of indexing multimedia documents according to claim 18, characterized in that each[[~~a~~]] frame comprises about 512 samples to about 2,048 samples of a~~the~~ sampled audio document.

20. (CURRENTLY AMENDED) ~~An indexing method~~A method of indexing multimedia documents according to claim 18, characterized in that the parameters taken into account to define the terms t_i comprise

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time information selected from the group consisting of~~corresponding to at least one of the following parameters~~: an~~the~~ energy level of ~~the~~ audio signal frames, a~~the~~ standard deviation of frame energy levels~~ies~~ in the clips, a~~the~~ sound variation ratio, a~~the~~ low energy ratio, a~~the~~ rate of oscillation about a predetermined value, a~~the~~ high rate of oscillation about a predetermined value, a~~the~~ difference between a~~the~~ number of oscillation rates above and below the mean oscillation rate for the frames of the clips, a~~the~~ variance of the oscillation rate, or a~~the~~ ratio of silent frames.

21. (CURRENTLY AMENDED) ~~An indexing method~~A method of indexing multimedia documents according to claim 18, characterized in that the parameters taken into account for defining the terms t_i comprise frequency information selected from the group consisting of:~~corresponding to at least one of the following parameters:~~

a~~the~~ center of gravity of a~~the~~ frequency spectrum of a~~the~~ short Fourier transform of an~~the~~ audio signal, a~~the~~ bandwidth of the audio signal, a~~the~~ ratio between an ~~the~~ energy level in a frequency band to a~~the~~ total energy level in the ~~entire~~ frequency band of the sampled audio signal, a~~the~~ mean value of spectrum variation of two adjacent frames in a clip, and a~~the~~ cutoff frequency of a clip.

22. (CURRENTLY AMENDED) ~~An indexing method~~A method of indexing multimedia documents according to claim 18, characterized in that the parameters taken into account for defining the terms t_i comprise at least energy modulation at 4 Hz.

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23. (CURRENTLY AMENDED) ~~An indexing method~~A method of indexing multimedia documents according to claim 1, characterized in that the shape[[~~s~~]] of the~~an~~ image of the~~a~~ multimedia document are analyzed using the following steps:

a) performing multiresolution followed by decimation of the image;

b) defining the image in polar logarithmic space;

c) representing a~~the~~ query image or an image portion by its Fourier transform H;

d) characterizing the Fourier transform H as follows:

d1) projecting H in a plurality of directions to obtain a set of vectors of dimension equal to a~~the~~ projection movement dimension; and

d2) calculating ~~the~~ statistical properties of each projection vector; and

e) representing the shape of the image by a term [[~~t~~$_i$]] constituted by values for the statistical properties of each projection vector.

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